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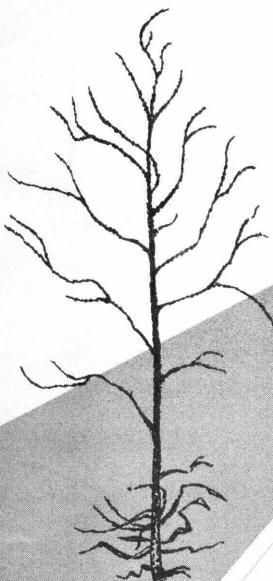
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U. S. DEPARTMENT OF AGRICULTURE  
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for the

# Shelterbelts



## NORTHERN GREAT PLAINS

Farmers' Bulletin No. 2109

UNITED STATES DEPARTMENT OF AGRICULTURE

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Washington, D.C.

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# *Shelterbelts* for the NORTHERN GREAT PLAINS

By ERNEST J. GEORGE, *Research Forester*<sup>1</sup>,  
*Crops Research Division, Agricultural Research Service*

Shelterbelts, or windbreaks, are trees and shrubs planted to act as barriers against strong winds and drifting snows. They are grown in the generally treeless northern Great Plains to protect crops, cultivated land, livestock, farm buildings, and homes.

The northern Great Plains includes the western halves of North and South Dakota, the plains portion of Montana lying east of the foothills of the Continental Divide, and the northern third

of Wyoming. The region has low average rainfall, frequent droughts, and extremes of heat and cold. Winds dry out and blow away exposed topsoils. Winds sweep snow into ravines and coulees where the resultant moisture becomes a flood hazard and does not benefit crops. Winds damage crops at germination and later. Success of crops may depend on whether they have shelterbelt protection.

## BENEFITS OF SHELTERBELTS

Properly designed shelterbelts slow down speed of the wind by splitting air currents. Part of the wind is diffused through the belt and part of it is diverted upward and over the top. This creates an island of relatively calm air near the ground on the downwind, or leeward, side of the shelterbelt.

Effectiveness of a shelterbelt de-

pends on the height of the trees, their growth density, and their uniformity of height in each row. The taller the trees, the farther the protection extends.

Shelterbelts offer specific benefits to the Plains farmer or rancher:

- They improve growing conditions for his orchard, garden, and field crops. By slowing down wind speed, shelterbelts reduce the possibility of firing,

<sup>1</sup>U.S. Northern Great Plains Research Center, Mandan, N. Dak.

wind breakage, and blowdown. By creating relatively calm air close to the ground, they prevent quick evaporation of potential soil moisture and aid in reducing loss of topsoil from wind erosion. Preventing quick evaporation helps in the germination of crops. It may also prevent premature ripening of grain. Reducing soil blowing lessens the possibility of injury to germinating seedlings.

- They improve his living and working conditions. Belts protect his home and farm buildings from hot or cold winds. The home is cooler in summer and warmer in winter. Trees and

shrubs make his farmstead more attractive and add to its value. They also prevent snowdrifts from blocking roads and accumulating against buildings.

- They provide winter protection to livestock and feeding grounds. Belts protect feeding areas from drifting snow. Feed is easier to distribute. In a normal winter, cattle wintered in tree-protected feeding grounds gain more than those wintered in unprotected areas. Also, cattle wintered in tree-protected areas lose less weight during severe blizzards than those wintered in exposed locations.

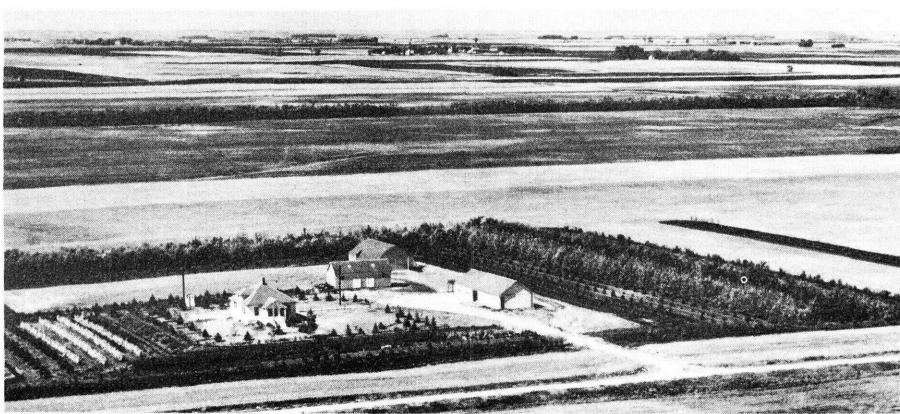
## GROWING SHELTERBELTS

Climatic conditions of the northern Great Plains do not favor tree growth. However, you can grow shelterbelts successfully in this region if you—

- Plan in complete detail ahead of planting.
- Select the right trees and shrubs.
- Plant them in the right way.
- Maintain them.

### Planning

A shelterbelt is a long-range improvement. You take the land it covers permanently out of cash-crop production. Trees and labor will cost you about \$50 per acre. Shelterbelt benefits will more than pay for this initial cost by the third year of growth. For example, the control of snowdrifts



A 750-55

This farm home and the other buildings are well protected against wind and drifting snow.



SHELTERBELT 1585

**A well-planned windbreak holds snow in the trees, prevents it from drifting around farm buildings.**

reduces the use of labor and machinery to clear snow-blocked feedlots, yards, and roads. Benefits will increase with tree growth.

Get advice on a plan that best meets your needs. Get it from the Soil Conservation Service technician assisting your local soil conservation district; from your county agricultural agent, State or extension forester, or agricultural college; or from the U.S. Northern Great Plains Research Center. Put down on paper details about the size and shape of the site, the spacing distances that you will use in setting out trees, and the numbers, kinds, and arrangement of species. Here are guides to use in developing your planting plan:

*Locate your shelterbelt correctly in relation to prevailing winds and what it must protect.*

To shield farm buildings against winds from the north and northwest, use an L-shape planting on those sides. Place the inside, or leeward row at least 50 feet and no more than 100 feet from the nearest building used during the winter months. The distance you leave between the leeward row and the building depends on the

number of rows—the greater the number of rows, the closer the distance. You can plant one shrub row on the south and east to hold snow drifting from those directions.

Plan belts on three sides of orchards and gardens. South and west belts give protection against heat. A north belt shields against strong winds that may blow fruit off trees or erode top-soil. Leave the east side open to avoid frost damage caused by still air.

Allow at least 50 feet between belts and orchard or garden. Trees that are any closer will compete for soil moisture and reduce yields.

When you choose a planting location where the belt will give effective protection, you have little opportunity to select the most favorable site for tree growth. Sites that are level or that slope gently to the north or east are preferable. Coarse-textured soils, such as sandy loams, will give best results under dryland conditions. Finer textured soils, such as clay loam and clays, will grow trees successfully if supplemental water is used.

Expect poor results when you plant trees in soils underlain by hardpan, in alkali spots, or on sites that have been



A windbreak on the north keeps strong wind and drifting snow out of this feedlot.

heavily manured or in corrals for many years.

*Provide protection without unnecessary use of land.*

A properly designed Plains shelterbelt gives some reduction in wind velocity for a distance of  $20H$  (20 times the average height of the trees). Such belts will have a winter density of 15 to 20 percent in the bottom 3 feet and 40 to 60 percent above that height. A large field requires a windbreak system—a main belt on the windward sides and a number of supplemental belts. Some of these may run in an east-west direction and some north-south.

To prevent snow drifts and icy areas from forming on highways, do not plant trees close to section or quarter lines that are used as roads during the winter months. Locate belts at least 200 feet from the center of the road. Start and end tree rows at similar distances.

Plant a larger number of rows for farmstead, livestock, and feedlots than

for garden and orchard, and for main and supplemental belts. Do not plant more than eight rows; more rows increase the competition for soil moisture and give little additional benefit. Unless your site is very much exposed, plant the least number of rows in the following recommendations:

Purpose:	Number of rows
Farmstead	5 to 8
Feedlot	5 to 8
Field (main belt)	1 or 2
Field (supplemental belt)	1
Garden or orchard	1 or 2

Allow these spacings:

Between field belts:	Feet
Main and first supplemental belt	330 to 412
Other supplementals	250 to 412

Between rows:	
Two-row belts	12
More than two rows	15 to 18

Between trees and shrubs in the row:	
Shrubs in single and windward rows	4 to 6
Trees in single rows	6
Trees in multiple-row belts	8

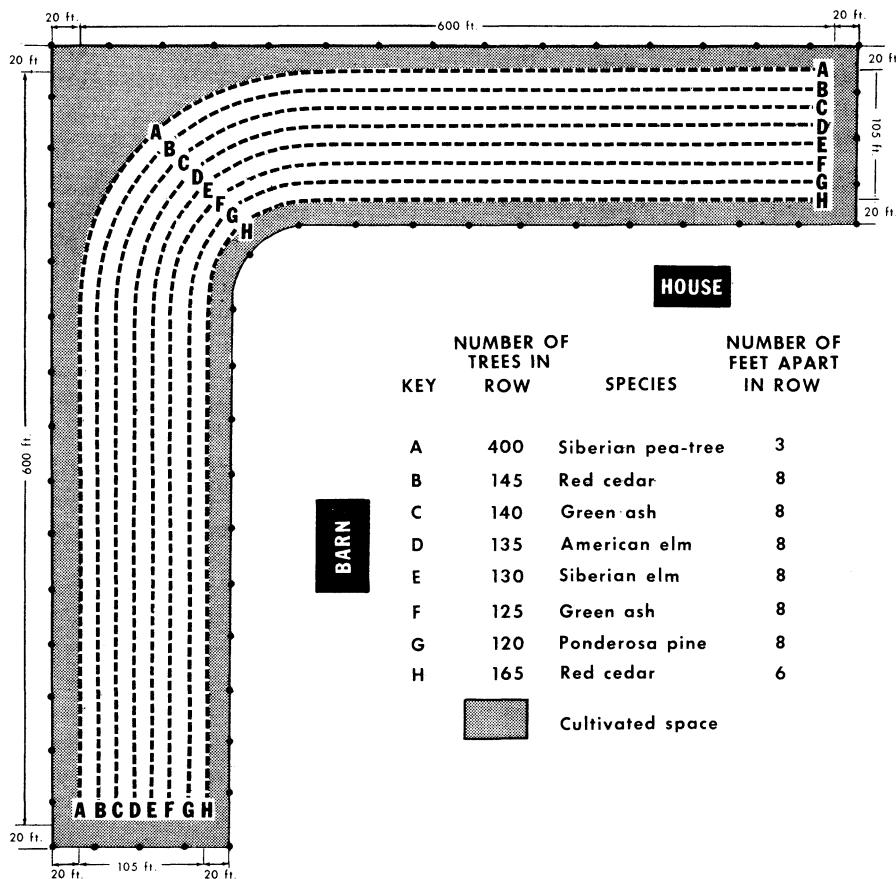
*Plan adequate protection against wind erosion.*

Some soils will erode when exposed to winds of 15 miles per hour. Provide a windbreak system to prevent winds from sweeping across fields. Tree belts that permit some wind to blow through their lower parts will give longer distance protection than belts that permit little or no wind to pass through. Space supplemental belts closer together if you use low-growing species. The area protected is determined by height of the wind-

break and direction of wind in relation to its orientation. Shelterbelts planted at right angles to the prevailing wind offer the greatest protection. Those planted almost parallel to prevailing wind offer the least. Avoid large openings in belts. Winds build up velocity as they are concentrated in passing through gaps.

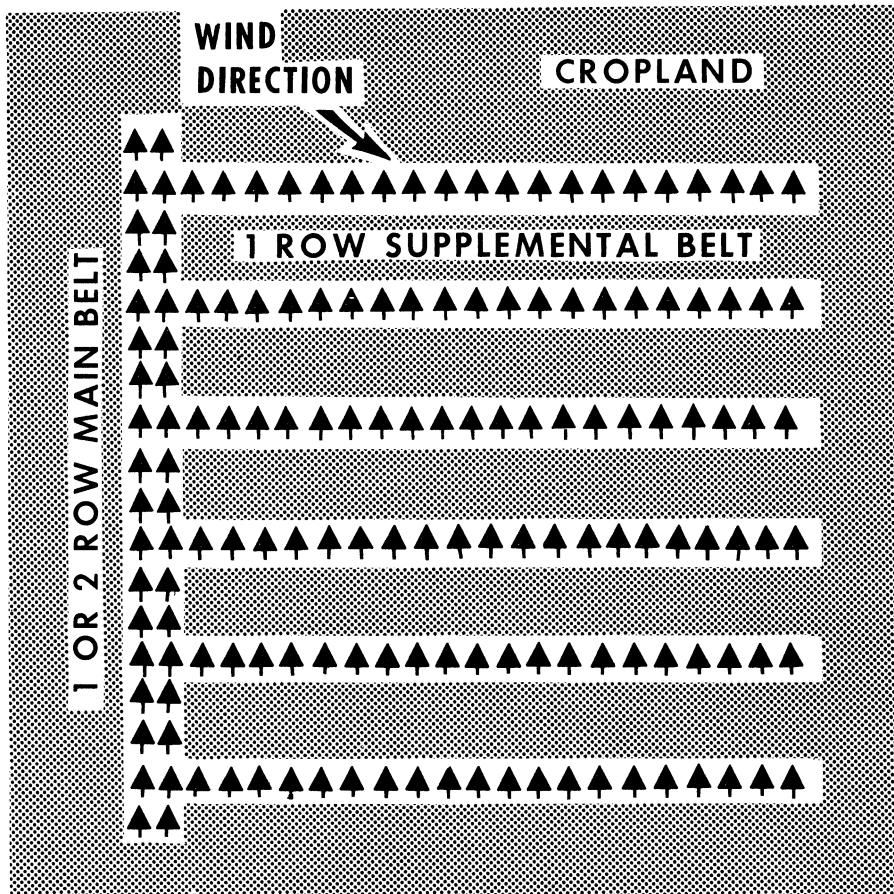
*Prepare land to store the maximum amount of moisture.*

Fit your method of preparation to the condition of the land. Summer fallow your tree site a year ahead of



**Plan for an 8-row windbreak to protect farm home and buildings. Prepare a similar plan, showing all essential information, for each planting.**

BN 3810



This field shelterbelt system is the minimum needed to give adequate wind protection to a quarter section of crop land. Light sandy soils may require one or two more supplemental belts and a checkerboard system of planting to fully control soil blowing.

planting on most croplands. Practice clean cultivation for 2 years on established grasslands. Put cover crops on light sandy soils that are subject to blowing. Follow good water conservation practices, such as terracing, diking, or building of water diversion structures, on drier lands.

*Build a fence around the site to keep out livestock.*

Their browsing of lower branches

and bark on trunks destroys lower cover and injures and sometimes kills trees. Trampling packs the soil, preventing it from readily absorbing moisture.

*Arrange species so that, when they reach full growth, the tops will form a roof-shaped outline.*

The slope on the windward side of the "roof" should be longer than on the leeward side.

Indicate the desired arrangement on your planting plan, as follows:

- In the outside row on the windward and leeward sides of farmstead and feedlot belts, use trees or shrubs that will form a dense growth close to the ground. These outside rows are not needed for field, supplemental, garden, or orchard belts.

- Between these rows and the center, use taller-growing species arranged according to the height they will reach—a gradual progression upward as the center rows are approached.

- In the center rows or in the rows on the leeward side of the center rows, plant the tallest-growing trees.

Table 1 lists recommended tree and shrub species by outside, intermediate, and center row location in shelterbelts and tells how suitable they are for dryland planting.

## Selecting Trees

You can buy trees from commercial nurseries, grow them from seed, or transplant them from nearby wood-

lands. For best results on the Plains, use nursery trees. Choose those grown from seed that was collected locally or from known hardy species in other localities.

Year-round leafage is important in the effectiveness of a windbreak. Choose a combination of deciduous (leaf-shedding) species and evergreen coniferous species.

Select seedlings of deciduous species that measure  $\frac{1}{4}$  to  $\frac{3}{8}$  inch in diameter just above the swelling of the root collar. Generally, these seedlings will be 18 to 36 inches tall. Select seedlings that have good root systems.

Your stock of coniferous species may be transplants or potted stock. Choose trees that are 6 to 12 inches high and 3 to 5 years old.

Be sure to have enough trees to allow you to select those most suitable and to discard any that are undersized or injured. Get about 20 percent more trees than you will need in your planting plan. Put the surplus in temporary nursery rows as replacements for losses.



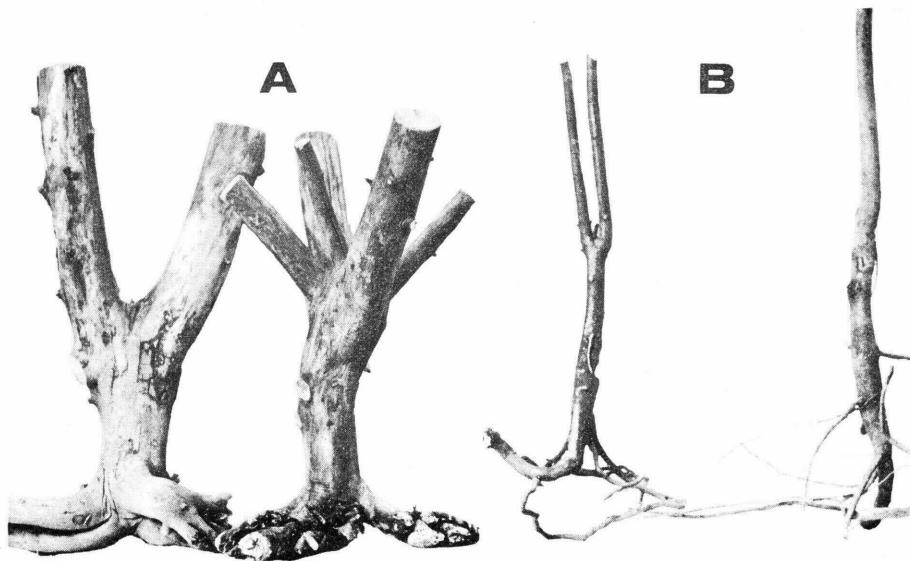
This well-designed system of field windbreaks in eastern North Dakota gives good protection to field crops.

TABLE 1.—*Species of trees and shrubs rated as to suitability for planting in farmstead,**feedlot, and field shelterbelts on dryland sites in the northern Great Plains*

[All these species grow well on sites where supplemental water is available]

Species	Suitability ratings		
	Light soil	Medium soil	Heavy soil
PLANTINGS IN OUTSIDE ROWS			
<b>Deciduous species:</b>			
Buffaloberry, silver <sup>1</sup> . . . . .	Fair	Good	Good
Crab, Siberian <sup>2</sup> . . . . .	Good	Good	Fair
Currant, golden . . . . .	Good	Good	Good
Honeysuckle, Tatarian . . . . .	Good	Good	Fair
Lilac, common <sup>3</sup> . . . . .	Good	Good	Fair
Lilac, Persian <sup>3</sup> . . . . .	Good	Good	Fair
Maple, Amur . . . . .	Poor	Poor	Not suited
Pea-tree, Siberian <sup>2 4</sup> . . . . .	Good	Good	Good
Plum, American . . . . .	Fair	Fair	Not suited
Russian-olive <sup>2</sup> . . . . .	Good	Good	Fair
Serviceberry . . . . .	Good	Good	Fair
Sumac, skunkbush . . . . .	Fair	Good	Good
<b>Coniferous species:</b>			
Redcedar <sup>1</sup> . . . . .	Good	Good	Good
Rocky Mountain juniper <sup>1</sup> . . . . .	Good	Good	Good
Spruce, Black Hills . . . . .	Fair	Fair	Not suited
Spruce, blue . . . . .	Fair	Fair	Poor
PLANTINGS IN INTERMEDIATE ROWS			
<b>Deciduous species:</b>			
Ash, green <sup>2 5</sup> . . . . .	Good	Good	Fair
Boxelder . . . . .	Fair	Fair	Not suited
Hackberry <sup>2</sup> . . . . .	Fair	Fair	Not suited
Maple, silver . . . . .	Fair	Poor	Not suited
Oak, bur . . . . .	Good	Good	Fair
Russian-olive . . . . .	Good	Good	Fair
Willow, laurel . . . . .	Not suited	Not suited	Not suited
Willow, white . . . . .	Not suited	Not suited	Not suited
<b>Coniferous species:</b>			
Pine, limber . . . . .	Good	Good	Fair
Pine, ponderosa <sup>2</sup> . . . . .	Good	Good	Good
Pine, Scotch <sup>2</sup> . . . . .	Fair	Fair	Not suited
Spruce, Black Hills . . . . .	Fair	Fair	Not suited
Spruce, blue . . . . .	Fair	Fair	Poor
PLANTINGS IN CENTER ROWS			
<b>Deciduous species:</b>			
Elm, American <sup>2</sup> . . . . .	Good	Fair	Poor
Elm, Siberian <sup>2 4</sup> . . . . .	Good	Good	Good
Elm, Dropmore <sup>2 4</sup> . . . . .	Good	Good	Good
Maple, silver . . . . .	Fair	Poor	Not suited
Plains cottonwood <sup>2</sup> . . . . .	Not suited	Not suited	Not suited
Willow, laurel . . . . .	Not suited	Not suited	Not suited
Willow, white <sup>2</sup> . . . . .	Not suited	Not suited	Not suited

<sup>1</sup> See section on control of diseases.<sup>2</sup> Suitable for field shelterbelts.<sup>3</sup> This species has suckering habits.<sup>4</sup> Do not plant on wet sites.<sup>5</sup> See section on control of insect pests.



SHELTERBELT 1558

These 10-year-old tree roots got no deeper in the soil than they were when planted; they did not penetrate the hardpan layer. (A) Northwest poplar roots planted in northern South Dakota, (B) Green ash roots planted in northern North Dakota.

## Planting

*Care Before Planting.*—Packed in bundles, nursery trees keep a week to 10 days. Unpack them in a cool, protected place as soon as possible. If you will be ready to plant within a week, wet down the packing material, repack it around the roots, and keep the trees in a cool cellar or barn.

If you will not start planting for a week or more, heel in your trees in a cool, shaded location. To heel in, dig a trench 9 to 12 inches wide, with one straight and one sloping side, and about 1 foot deep. Open bundles and spread out trees evenly with the roots resting on the bottom of the trench and the tops pointing up the sloping side. Cover the roots with loose moist soil and water them well. Fill in the trench with soil and pack firmly.

*Time To Plant.*—Plant in the spring after frost is out of the ground and before trees begin to send out leaves.

Do not plant in the fall. Fall-planted trees in heavy soils may be heaved out of the ground during the winter. If you receive nursery trees in the fall, heel them in until spring.

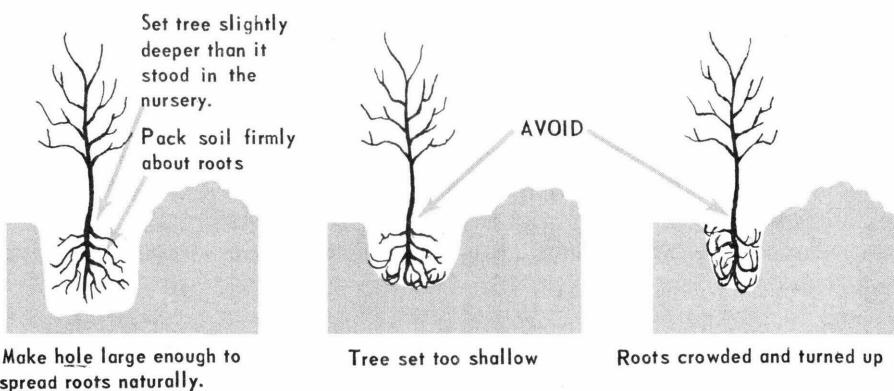
*How To Plant.*—Consult your planting plan before setting out trees. Most shelterbelt trees are now planted by machine. Set stakes to establish the first row and set the marker for correct distances between rows. If you plant by hand, use stakes and stretch lines between them to be sure of having straight, correctly spaced rows.

Some soil conservation districts rent mechanical tree planters, and send experienced men to operate them. Opening the trench, planting the trees,



SHELTERBELT 1732

These seedlings have good root systems. Left to right: Siberian elm, Russian olive, American elm, and green ash.



BN 3809

Correct and incorrect practices in planting trees.

closing the trench, and packing the soil are done in one operation.

Observe these basic rules whether you plant by hand or machine:

- Keep roots moist at all times. Carry trees in a large pail of water or on a tray covered with wet burlap and wood shavings or moss.

- Make a hole or trench wide and deep enough to permit roots to spread naturally without crowding or curling.

- Set the tree a little deeper than it stood in the nursery.

- Pack soil firmly around the roots.

Use a long-handled, straight-shanked shovel for planting by hand. Dig a hole for stock that has bushy roots. Put stock that has very few lateral roots in a slit or trench you can make by inserting the shovel in the ground and working it back and forth.

## MAINTAINING SHELTERBELTS

### Replanting

Replant in the spring of the second year to replace trees and shrubs that have died. Mark the dead trees in each row before freezing temperatures kill the leaves on living trees. A good time to make the count is the last week in August or the first week in September of the first year.

Don't delay replanting. Trees set out a few years after the first planting cannot compete successfully with older trees for moisture.

### Cultivating

Under dryland conditions, maintain 20 feet of clean-cultivated space on all sides of the belt. If the land is irrigated, keep down weeds and grass to prevent fire.

Practice clean cultivation between rows as long as you can work with equipment or until tree crowns shade out weeds and grass. Use a duckfoot cultivator or spring-tooth harrow. Use a single section of the harrow when rows become too narrow for the full equipment.

Practice clean cultivation between trees in the row. You can buy a spe-

cial side attachment for your tractor or you may be able to rent one from the soil conservation district.

If you plant in sandy soils subject to blowing, put garden crops or corn between rows, or put grain in the centers between trees. Allow at least 3 feet between crops and trees. You also can use a mulch of hay, straw, or manure in the control of water or wind erosion. Do not mulch as a substitute for clean cultivation.

You can use herbicides to control weeds in shelterbelt plantings. Be sure that spray preparations, such as 2,4-D, do not get on trees or shrubs. Consult your State extension forester or county agricultural agent for the latest herbicide recommendations.

### Pruning

Limit pruning of trees to corrective pruning at the beginning of the second year of growth or the year after an injury occurs. At time of planting, cut back tops of hedge-type species, such as Siberian pea-tree, in outside rows of farmstead and feedlot plantings to encourage branching close to the ground. Do not cut back tops of hedge species

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## PRECAUTIONS

Herbicides used improperly can be injurious to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Some States have special restrictions on the use of certain herbicides. Before applying pesticides, check State and local regulations.

Keep herbicides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them.

When handling a herbicide, wear clean, dry clothing.

Avoid repeated or prolonged contact of herbicide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of herbicide dusts or mists.

Avoid spilling a herbicide concentrate on your skin, and keep it out of your eyes, nose, and mouth. If you spill any on your skin or clothing, remove contaminated clothing immediately and wash the skin thoroughly with soap and water. Launder the clothing before wearing it again.

After handling a herbicide, do not eat, drink, or smoke until you have washed your hands and face. Wash any exposed skin immediately after applying a herbicide.

To protect water resources, fish, and wildlife, do not contaminate lakes, streams, or ponds with herbicide. Do not clean spraying equipment or dump excess spray material near such water.

Avoid drift of herbicide to nearby crops.

Dispose of empty herbicide containers at a sanitary land-fill dump, or bury them at least 18 inches deep in a level, isolated place where they will not contaminate water supplies. If you have trash collection service, wrap small containers in heavy layers of newspapers and place them in the trash can.

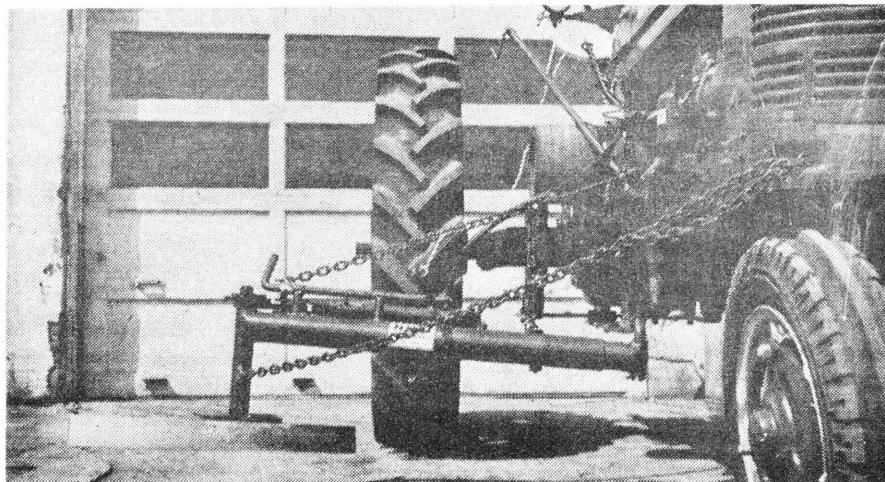
It is difficult to remove traces of herbicides from equipment. For this reason, do not use the same equipment for applying herbicides that you use for insecticides and fungicides.

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used for field shelterbelts, as low branching is undesirable. Don't allow development of more than one main trunk for interior-row trees, such as ash, elm, hackberry, and poplar. If a double leader appears on an evergreen tree, remove the weaker of the two branches.

Restrict pruning of side branches to those growing less than 1 foot above

the ground. Cut off branches close to the trunk so that no stubs are left to decay. Use a sharp knife or pruning shears. Paint large wounds with a dressing, such as asphalt paint, which is obtainable from most paint stores. Thin the dressing with mineral oil in cold weather or whenever the mixture does not adhere readily to the wound.



This in-the-row cultivator, which can be attached to any make of tractor, will remove nearly all the weeds between trees in the row.

## Controlling Diseases

Two species of trees listed in table 1—redcedar and Rocky Mountain juniper—are alternate hosts of fungi that cause cedar apple rust and hawthorn rust. Do not plant these species in commercial apple-growing areas.

The common barberry is often found in or near shelterbelts. It is the alternate host of stem rust of wheat. Do not use this shrub for shelterbelt or ornamental use. Destroy native and cultivated shrubs of this species.

Several species are damaged by canker fungi, heart rot, and wetwood. Cankers weaken the stems of poplars and willows so much that they may break during storms. Poplar canker will attack both vigorous and weak trees. Remove trees when cankers have caused extensive dieback of the tops.

Heart rots infect some species, including silver buffaloberry, and cause breakage of trunks and limbs. Fungi that cause heart rot often enter

through wounds. Avoid unnecessary wounding. Keep your trees and shrubs in vigorous condition.

Wetwood of poplar is caused by bacteria that infect the wood and produce toxins. The toxins cause dieback of the tops and may kill the trees. No control measure for wetwood is known.

Leaf spot diseases caused by various fungi damage some species. The damage is seldom extensive enough to require control measures.

## Controlling Animal Pests

Rabbits are the major animal pests of shelterbelts on the northern Great Plains. They cause serious damage by eating shoots, branches, leaves, and buds and by gnawing and peeling off bark. Control them by organized hunting and by painting or spraying trees with chemical mixtures that will keep rabbits away.

If you plan rabbit hunts, be sure to comply with State game laws and regulations.

For information on protecting trees and shrubs from rabbit damage, see your county agricultural agent, or write to the U.S. Department of Agriculture, Washington, D.C. 20250. Please send your request on a post card and include your ZIP Code.

Pocket gophers eat through roots that may result in killing or uprooting of trees. Control them by placing traps in open runways or by using poisoned baits.

Field mice girdle or strip the bark off trees under the snowline during the

winter. They build nests in thistles and other weeds that accumulate near trees in late fall. Prevent field mice damage by clean cultivation.

### Controlling Insects

Make your trees less subject to insect attack by maintaining them in vigorous growing condition. If control measures become necessary, get advice from your county agricultural agent or from the U.S. Northern Great Plains Research Center, Mandan, N. Dak. 58554.



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### ADDITIONAL INFORMATION

For further information on shelterbelts, ask your county agricultural agent or the local Soil Conservation Service representative for your soil conservation district.

Advice on species of trees and shrubs and local control measures for diseases, animal pests, and insect pests may be obtained from the following:

In North Dakota—U.S. Northern Great Plains Research Center at Mandan; U.S. Forest Service Research Center at Bottineau; State extension

forester or agricultural experiment station at Fargo.

In South Dakota—extension forester or agricultural experiment station at Brookings.

In Montana—extension forester or agricultural experiment station at Bozeman.

In Wyoming—extension forester or agricultural experiment station at Laramie or Cheyenne Horticultural Field Station.